Blue: A Database for High-fold Coincidences

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The high sensitivity of modern gamma-ray spectrometers such as Gammasphere, Euroball and future instruments such as Greta is realized by dispersing weakly correlated background events over a space of high dimensionality or fold. The optimal fold for the analysis of high-spin nuclear structure experiments with Gammasphere is 4 and for Greta it will probably be 7 or 8. Historically, 2 or 3 fold correlation data were stored in simple histograms indexed on each axis by the energies of the coincident gamma-rays. The accompanying figure shows the number of histogram cells required for the storage of symmetrized coincidences (for resolutions d of 1024, 2048 and 8192 channels) as a function of fold. Due to the near logarithmic growth of histogram size with fold, this method quickly becomes impractical. However, it is now feasible to directly store the coincident energies from the approximately 10^9 events collected during a typical Gammasphere experiment. The challenge is to effectively organize these coincidences, such that one can interactively query such datasets.

To address this problem we have developed *Blue*, a list-mode database which is effective for gamma-ray coincidence data of folds 4 through 8. The algorithm used to organize the list of coincident energies employs a tree-like index, similar to a *kd*-tree [1] [2], which adapts to the density distribution of coincidences in the hypercube. This partitions the data so that queries, such as taking multidimensional gates, require access to only a very small fraction of the database. This indexing mechanism also facilitates a simple compression scheme and is used as an adaptive buffer for a two phase tape sort. Queries such as taking an $(f-1)$-fold gate on f-fold data can be done interactively on a modern workstation. The query time is largely fold independent.

The database is implemented as a library of functions to allow it to be linked to existing analysis and histogram display programs. Routines for several types of queries, sorting and database manipulation have been successfully implemented. The program has been developed for Unix systems supporting 64−bit filesystems and is currently run under Irix 6.5.2.

An interface to *Blue* has been written so that databases corresponding to different folds from the same dataset may be queried simultaneously. This allows all data to be stored in its native fold which is required for space efficiency in a list-mode database. This also assures spike-free gating.

References

[1] J.L. Bentley, *Commun. ACM*, **18** 509, 1975

[2] J.L. Bentley, *IEEE Trans. Softw. Eng.*, **SE−5** 333, 1979